TBM 8E, 26.2.2014

① $h(t) = -5t^2 - 10t + 300$

$v(t) = -10t - 10$

a) $h(t) = 0 \Rightarrow t \approx \underline{6.81\,s}$

$v(t = 6.81s) = \underline{-78.1025\ m/s}$

b) $h(t) = 100 \Rightarrow t_1 \approx 5.4\,s$

$h(t) = 200 \Rightarrow t_2 \approx 3.58\,s$

$\Delta t = \underline{1.82\,s}$

$v(t_1) = -64.63\ m/s$

$v(t_2) = -45.83\ m/s$

$\bar{v} = \underline{-54.93\ m/s}$

c) Fallzeit ist $6.81s - 1s \approx 5.81s$

$-5t^2 + v_0 t + 300 = 0$ für $t = 5.81s$

$v_0 \approx \underline{-22.582\ m/s}$

② F: $s_1(t) = 0.1t^2 + 25t$ $\quad v_1(t) = 0.2t + 25$

BMW: $s_2(t) = -0.15t^2 + 40t + 500$ $\quad v_2(t) = -0.3t + 40$

b) $s_1(t) = s_2(t) \Rightarrow t = \underline{83.85\,s}$

$v_1(t = 83.85s) = \underline{41.77\ m/s}$

$v_2(\ \ " \ \ ) = \underline{14.84\ m/s}$

$s_1(\ \ " \ \ ) = \underline{2799.4m}$

$s_2(\ \ " \ \ ) = 2799.4\,m$

$2799.4m - 500m = \underline{2299.4m}$

c) $s_1(t) = s_2(t) + 100m$

$t = 87.45\ m/s$

③ a) $F = D \cdot x$; $F_{start} = 20\ \frac{kN}{m} \cdot 0.1m = 2000N$

$F_{end} = 20\ \frac{kN}{m} \cdot 0.3m = 6000N$

$\overline{F} = \frac{2000N + 6000N}{2} = \underline{4'000\ N = 4kN}$

b) $E_{Feder} = E_{kin} = 800\ Joules$

$\frac{1}{2} D (0.3^2 - 0.1^2) = \frac{1}{2} m v^2$

$\sqrt{\frac{D}{m}(0.3^2 - 0.1^2)} = v = \underline{20\ m/s}$

c) $E_{kin} = E_{Reib}$

$\frac{1}{2} m v^2 = m g \mu s \quad | \cdot 2 : m$

$v^2 = 2 g \mu s$

$\frac{v^2}{2\mu g} = s = \underline{200\ m}$

d) $P = F \cdot v$; P prop. zu v !

d) und e) gehören zu Aufgabe 5 und nicht zu 3 !

d) Bremsen: $\frac{F_{Reib}}{m} = a = \mu \cdot g = -1\ m/s^2$

$t = 20s$; $P = \frac{E}{t} = \frac{800\ J}{20s} = \underline{40\ Watt}$

(4)

$F_{G_1} = 1000\,N = 100\,kg \cdot g$

$F_{G_4} + F_{G_5} = 400\,N = 10\,kg \cdot g + 30\,kg \cdot g$

$F_{Reib} = 300\,N = \mu m_3 g + \mu m_2 g$

$F_{Res} = 300\,N$

$m_{tot} = 240\,kg$ $\quad s = \frac{1}{2}at^2 = \frac{1}{2} \cdot \frac{5}{4} \cdot 0.5^2 = 0.1562$

a) $a = \frac{F}{m} = \frac{300\,N}{240\,kg} = \frac{10}{8} = \underline{\underline{\frac{5}{4}\,m/s^2}}$

b) $A: F_A = F_{G_5} + F_{G_4} + F_{Reib} + \frac{5}{4}\,m/s^2 \cdot 140\,kg$

$300\,N + 100\,N + 300\,N + 175\,N = \underline{\underline{875\,N}}$

$B: F_B = F_{G_5} + F_{G_4} + F_{Reib,\,m_3} + \frac{5}{4}\frac{m}{s^2} \cdot \underbrace{80\,kg}_{m_3 + m_4 + m_5}$

$= 300\,N + 100\,N + 120\,N + 100\,N = \underline{\underline{620\,N}}$

$C: F_C = 400\,N + \frac{5}{4}\frac{m}{s^2} \cdot 40\,kg = \underline{\underline{450\,N}}$

$D: F_D = 300\,N + \frac{5}{4}\frac{m}{s^2} \cdot 30\,kg = \underline{\underline{337.5\,N}}$

(5) $m = 2'000\,kg$, $t = 35$, $\mu = 0.68$, $\eta = 0.21$

a) $F = \mu m g = 0.68 \cdot 2000 \cdot 10 = 13'600\,N$

$a = \frac{F}{m} = \mu \cdot g = 6.8\,m/s^2$

$v = a \cdot t = 6.8\,m/s^2 \cdot 35 = \underline{\underline{20.4\,m/s}}$

b) $E = \frac{1}{2} m v^2 = \frac{1}{2} \cdot 2000 \cdot (20.4)^2 = 416'160\,J$

$P = \frac{E}{t} = 138'720\,W = \underline{\underline{138.72\,kW}}$

$P = F \cdot v$ (momentane Leistung)

$\Rightarrow$ Leistung proportional zu v !

c) aus b): $E = 416'160\,J \;\hat{=}\; 21\,\%$

$1'981'710\,J \;\hat{=}\; 100\,\%$

$\frac{1.98171\,MJ}{31.5\,MJ} = \underline{\underline{62.912\,ml}}$

a) Strecke $s = \frac{1}{2} a t^2 = \frac{1}{2} \cdot 6.8 \cdot (\cancel{t=5}\ 3)^2$

$= \frac{1}{2} \cdot 6.8 \cdot 3^2 = 30.6\,m$

halbe Strecke $= 15.3\,m$

$s = \frac{v^2}{2a} \Rightarrow v = \sqrt{2as} = \underline{\underline{14.425\,m/s}}$